

13. Sequence VIII LTMS Requirements

The following are the specific Sequence VIII calibration test requirements. For purposes of the Sequence VIII, a test stand is defined as an engine/stand combination.

A. Reference Oils and Parameters

The critical parameter is Total Bearing Weight Loss (TBWL). The reference oils required for test stand and laboratory calibration are reference oils accepted by the ASTM Sequence VIII Surveillance Panel. The means and standard deviations for the current reference oils for the critical parameter are presented below.

TOTAL BEARING WEIGHT LOSS
Unit of Measure: mg
CRITICAL PARAMETER

Reference Oil	Mean	Standard Deviation
704-1	8.3	2.32
1006	15.9	4.85
1006-2	17.5	4.23
1009-1	16.2	3.48

10-HOUR STRIPPED VISCOSITY
Unit of Measure: centistokes
NONCRITICAL PARAMETER

Reference Oil	Mean	Standard Deviation
704-1	10.27	0.11
1006	9.00	0.17
1006-2	9.37	0.07
1009-1	9.73	0.07

B. Acceptance Criteria

In addition to the calibration test requirements described below for new and existing test stands:

- A new bearing batch requires a minimum of two (2) operationally valid calibration tests with no stand Shewhart alarms per laboratory.

1. New Test Stand

a. Less than six (6) Operationally Valid Calibration Results in Laboratory

- A minimum of two (2) operationally valid calibration tests, with no stand Shewhart severity or precision alarms, must be conducted using the same bearing batch/lot combination on reference oils 704, and/or 1006, or subsequent approved reblends.
- All operationally valid calibration test results must be charted to determine if the test stand is currently “in control” as defined by the control charts from the Lubricant Test Monitoring System.

b. Six (6) or more Operationally Valid Calibration Results in Laboratory*

- The first operationally valid calibration test run on any approved reference oil must have no stand Shewhart severity alarm and no stand Shewhart precision alarm using the “Reduced K” values. If the first operationally valid calibration test does not meet this acceptance criteria, then the New Test Stand criteria listed above in 1.a must be followed.

- * Only test results from calibrated stands in the laboratory count towards the tally of six (6) required operationally valid calibration tests. The sixth test must complete (date and time) before the first test completes (date and time) on a New Test Stand that is seeking calibration with a single test result. In addition, the first test for the stand is to begin within six (6) months of the completion of the last acceptable calibration test. Also, there must not be any outstanding precision alarms for the laboratory.

2. Existing Test Stand

- The test stand must have previously been accepted into the system by meeting LTMS calibration requirements.

3. Reference Oil Assignment

Once test stands have been accepted into the system, the TMC will assign reference oils for continuing calibration according to the following reference oil mix:

- 100% of the scheduled calibration tests should be conducted on reference oil 1009-1, or subsequent approved reblends.

4. Control Charts

In Section 1, the construction of the control charts that constitute the Lubricant Test Monitoring System is outlined. The constants used for the construction of the control charts for the Sequence VIII, and the response necessary in the case of control chart limit alarms, are depicted below.

LUBRICANT TEST MONITORING SYSTEM CONSTANTS

		EWMA Chart				Shewhart Chart	
		LAMBDA		K		K	
Chart Level	Limit Type	Precision	Severity	Precision	Severity	Precision	Severity
Stand	Reduced K	--	--	--	--	1.31	1.66
	Action	0.3	0.3	1.46	1.80	1.64	1.96
Lab	Warning	0.3	--	1.46	--	--	--
	Action	0.3	0.2	2.33	1.80	1.64	1.96
Industry	Warning	0.2	0.2	1.46	1.80	--	--
	Action	0.2	0.2	2.33	2.58	--	--

The following are the steps that must be taken in the case of exceeding control chart limits. The steps are listed in order of priority, although charts should be studied simultaneously to determine the cause(s) of a problem. In the case of multiple alarms, contact the TMC for guidance.

- Exceed EWMA laboratory chart action limit for precision (critical parameter only)
 - Cease all candidate test starts in the laboratory. Develop plan to correct laboratory precision problem. Coordinate efforts with the TMC.
- Exceed EWMA laboratory chart warning limit for precision (critical parameter only)
 - Immediately begin two (2) calibration tests on calibrated test stands different from the test stand which exceeded the warning limit. (Calibration tests currently running on “existing” test stands may be used.) If a laboratory has two (2) test stands, conduct one (1) calibration test in each of those two (2) stands. If a laboratory has only one (1) test stand, conduct the two (2) additional calibration tests in that test stand. Notify the TMC for potential laboratory visit. Candidate testing may continue on other calibrated test stands.
- Exceed EWMA test stand chart limit for precision (critical parameter only)
 - Remove test stand from the system. Notify the TMC. Correct test stand precision problem. Follow requirements for entry of a new test stand into the system.
- Exceed Shewhart test stand chart limit for precision
 - Conduct an additional calibration test.
- Exceed Shewhart laboratory chart action limit for precision
 - Notify the TMC for guidance.

- Exceed EWMA laboratory chart action limit for severity (critical parameter only)
 - Calculate laboratory Severity Adjustment (SA) for TBWL, using the current laboratory EWMA (Z_i) as follows:
$$\text{TBWL: SA} = (-Z_i) \times (4.80)$$
 - Confirm calculations with the TMC.
- Exceed EWMA test stand chart limit for severity (critical parameter only)
 - Notify the TMC. If the direction of the test stand severity is deemed different from that of the test laboratory, conduct an additional calibration test in the identified test stand. If this limit is still exceeded after the additional calibration test, then remove test stand from the system, notify the TMC, correct test stand severity problem, and follow requirements for entry of a new test stand into the system.
- Exceed Shewhart test stand chart limit for severity
 - Conduct an additional calibration test.

The following Industry issues are handled by the TMC and do not require individual laboratory action.

- Exceed EWMA industry chart action limit (critical parameter only)
 - TMC to notify test sponsor, surveillance panel chairman, and ACC Monitoring Agency. Meeting of TMC, parts supplier, and surveillance panel required to determine course of action.
- Exceed EWMA industry chart warning limit (critical parameter only)
 - TMC to notify test sponsor, surveillance panel chairman, and ACC Monitoring Agency. Coordination of TMC, parts supplier, and surveillance panel chairman required to discuss potential problem.

Sequence VIII Reference Oil Targets							
Oil	n	Effective Dates		TBWL		10 Hr. Stripped Viscosity	
		From ¹	To ²	\bar{X}	s	\bar{X}	s
704-1	10 ⁴	8-29-98	11-16-99	7.9	3.40 ³	10.27	0.12 ³
	11	11-17-99	4-15-01	8.0	3.40	10.25	0.15
	23	4-16-01	12-16-01	8.3	2.44	10.29	0.11
	35	12-17-01	***	8.3	2.32	10.27	0.11
1006	10 ⁴	8-29-98	11-16-99	19.6	3.40 ³	9.09	0.12 ³
	10	11-17-99	4-15-01	17.1	5.28	9.00	0.22
	23	4-16-01	12-16-01	15.6	4.66	8.98	0.19
	32	12-17-01	***	15.9	4.85	9.00	0.17
1006-2	7	10-25-02	8-31-03	13.0	4.26	9.23	0.07
	12	9-1-03	5-14-04	12.4	2.59	9.24	0.06
	20	5-15-04	9-18-06	12.6	2.81	9.24	0.07
	--	9-19-06	3-11-07	15.9 ⁵	4.85 ⁵	9.24	0.07
	11	3-12-07	***	17.5	4.23	9.37	0.07
1009	5	1-7-03	1-23-05	12.8	2.00	9.51	0.10
	11	1-24-05	5-21-21	13.8	2.14	9.51	0.10
1009-1	4	10-5-23	***	16.2	3.48	9.73	0.07

- 1 Effective for all tests completed on or after this date.
- 2 *** = currently in effect.
- 3 Pooled s from GF-3 matrix analysis.
- 4 GF-3 matrix n-size.
- 5 Targets based on oil 1006.

History of Industry Correction Factors
Appendix B

Test Area	Effective		Condition	Correction
	From	To		
VH	March 16, 2021	Batches GI0321NX10 and GI0321NX10-1	Non reference tests	Subtract 0.32 from AES results for all non-reference oil tests completing on or after 3/16/21
IX	None		All Tests	None
IX Aged	None		All Tests	None
X	None		All Tests	None
Test Area	Effective		Condition	Correction
	From	To		
VIE	March 14, 2018 to ****		All Tests as noted adjacent	Add +0.21 to FEI1 and +0.22 to FEI2 Apply to Reference Tests completing on or after 3/14/18 Apply to Non reference tests on stand/engines referenced with correction factor applied. Apply correction factors to three previous reference tests completing before 3/14/18 in a given stand for purposes of Zi calculation.
VIF	None		All Test	None
VIII	October 5, 2023 to ****		All Tests	Add -0.14 to 10-Hour Stripped Viscosity and -3.6 to Total Bearing Weight Loss to all tests completing on or after October 5, 2023.